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SEASONAL VARIABILITY IN FOOD AND NUTRITION SECURITY AMONG CHILDREN 0-3 YEARS IN KARAMOJA SUB-REGION OF UGANDA

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ABSTRACT

Optimal nutrition and good feeding of infants and young children are among the most important determinants of their health, growth and development. Due to unimodal climate in Karamoja sub-region, north eastern Uganda, achieving food security remains a development challenge in the area impacting negatively on the nutrition and health status of infants and young children. The current study, therefore, is important in providing the basis for season-based interventions to improve food and nutrition security in Karamoja sub-region. A longitudinal study involving 267 lactating mothers during harvesting season and 380 during planting season was conducted. Data were collected using Individual level Dietary Diversity questionnaire, 24-Hour Dietary Recall, and Anthropometry and were analyzed statistically. The findings indicated that except Abim district, 77.8-97.8%of the lactating mothers never attended school; 75-100% depend on subsistence farming. Lactating mothers (29.9-41.9%) introduced complementary foods to their infants at 6 months, while the age at first introduction of any food to the infant was mostly between 4-6 months. Dietary quality of complementary foods was low across all the districts; 6.7-38.9% of the children ate foods from four or more of the seven food groups in the previous day (Minimum Dietary Diversity) in both seasons. Complementary foods were characterized by plant food sources. With exception of milk and milk products, proportion of children who consumed animal-sourced foods was low, ranging from 0% in meats to 8.9% in fish and sea foods. Energy and nutrient intakes varied according to age groups of the children across districts and season. The proportion of children below -2 Z-score also varied according to districts and it is generally higher during the planting season than the harvesting season. The median of the z-scores for height-for age and Mid Upper Arm Circumference for age ranged from -1 to -2.5. In conclusion, there were variations and disparities in dietary diversity, energy and nutrient intake as well as nutrition status of infants and young children across season and districts in Karamoja sub-region of Uganda. Therefore, interventions to combat malnutrition among children 0-3 years need to take into account seasonal variations for each of the geographical locations in Karamoja sub-region.

Key words: Child nutrition, Stunting, Nutrients, Anthropometry, Malnutrition, Karamoja, Uganda, NOURISH Project

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INTRODUCTION

Optimal nutrition and good feeding of infants and young children are among the most important determinants of their health, growth and development [1]. Management of child nutrition in the first three years of life has been found to be highly challenging because a child's feeding abilities and needs change concomitantly with motor, cognitive and social development [2]. On the other hand, proper child growth and development in the first two years is a good predictor of better education outcome. For instance, stunting at age of two years is recognized as a key impediment to attainment of full human capital at adulthood [3].

In Uganda, slow progress has been made in reducing malnutrition; the current levels of malnutrition hinder human and socio-economic development [4]. For instance, the Uganda Demographic Health Surveys (UDHSs) conducted in 2011 and 2016 revealed that among children below five years of age, stunting, wasting and underweight reduced from 32%, 5% and 14% in 2011 to 29%, 4% and 11%, respectively in 2016[5,6]. Undernutrition directly and indirectly contributes up to 60% of child mortality in Uganda [7]. This has been attributed to many factors, but poor dietary practices, high disease burden (attributed to malaria, diarrhea, tuberculosis, HIV AIDS), wide spread poverty, and gender inequality are considered to be the major factors [7].

Although many parts of Uganda enjoy adequate food security throughout the year due to favourable weather conditions, some parts of the country are food insecure [8]. A report by World Food Programme (WFP) [9] and the Integrated Food Security Phase Classification (IPC) Technical Working Group [10] revealed that Karamoja sub-region, located in the north eastern part of Uganda had the highest prevalence of food insecurity. More so, the sub-region, unlike the rest of Uganda, has a 'unimodal' climate with roughly six months of rains (April – October) followed by another six months of dry season. Thus, the sub-region benefits from only one annual harvest, which occurs around October [11]. This situation predisposes the infants and young children of Karamoja sub-region to the risk of food insecurity and consequently, malnutrition. This is worsened by crop failures.

Karamoja sub- region also has the highest prevalence of malnutrition in Uganda where 45% and 70% of children below five years of age were stunted and anemic, respectively [5]. According to government of Uganda annual health sector performance report for the fiscal year 2012, mortality of children below five years of age in the previous five years was highest in Karamoja sub-sub-region compared to other regions [12]. In the Karamoja sub-region, mortality rate of children below five years still remains high at 64 deaths per 1000 live births [5]. The mortality rate of children below five years in Karamoja sub-region could be higher than reported at national level due to high level of food insecurity experienced in the sub-region [9].

In rural environments such as the Karamoja sub-region, household food security is partly dependent on own agricultural production pathway [13]. By implication, therefore, any variation in agricultural production is likely to affect the nutrition

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situation. The fact that Karamoja sub-region has only one planting and one harvesting season suggests that food and nutrition security is influenced by season, consequently affecting nutritional status of children. Considering that infant and young children are an important vulnerable group for undernutrition, this study sought to examine empirically seasonal variability in food and nutrition security among children aged 0-3 years in the Karamoja sub-region of Uganda. Persistent malnutrition among infants and young children in the Karamoja sub-region is well documented in several health reports of Uganda government and Non-Governmental Organizations. The findings in this study should contribute to the existing data in the Karamoja sub-region in a quest to address challenges of infant and young child feeding.

MATERIALS AND METHODS

Study design and Study area

The study utilized a longitudinal design with two visits. The first visit took place during the harvesting season (October-December, 2014) and the second visit was undertaken during the planting season (April-June, 2015). The study was conducted in four districts of Karamoja sub-region selected on the basis of livelihood zones, geographical locations and ethnic background [14] and comprised Abim, Amudat, Kaabong, and Moroto. Karamoja sub-region has three broad livelihood zones: agricultural zone (mostly the western part of the region), agro-pastoral (mostly central part of the region), and pastoral zones (generally the eastern part of the region) [14]. The sub-region consists of five major ethnic groups: Dodoth in the north, the Jie in the central region, the Karamojong (subdivided into the Bokora, Matheniko, and Pian groups) in the south, the Pokot, in the southeast [14] and the Labwor in the west [15].

Sampling Procedure

Multi-stage sampling techniques were used. The four districts were selected purposively on the basis of geographical location, agro-ecological zones and the ethnicity. For each of the selected districts, the names of the sub-counties were written on separate pieces of paper, then pooled together and mixed. From this pool, two sub-counties were picked. From each of the sub-counties, two parishes were selected by systematic random sampling and finally, two villages per parish were obtained using systematic random sampling. With the assistance of village health teams/local council officials of each village selected, a total of 755 women of child bearing age were enrolled on voluntary basis in the preceding studies, out of which 267 were lactating in the harvesting season and 380 lactating in the planting season. The number of lactating mothers increased because some of the pregnant women who were part of the 755 women of child bearing age gave birth after the harvesting season. Therefore, the study involved a total of 267 lactating mothers in the harvesting season and 380 lactating mothers in the planting season. Lactating mothers were key respondents because mothers play a vital role in childcare and feeding practices [16].

Data Collection

Data were collected with the help of trained research assistants who were residents in the selected districts, familiar with the people and fluent in the respective local language. The first set of data was collected during the harvesting season (October-

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December 2014) and the second, during planting season (April-June 2015). Data collected included dietary assessment, anthropometry and socio-economic and demographic characteristics.

Dietary assessment was conducted by use of Individual level Dietary Diversity (IDD) questionnaire [17] and 24-Hour Dietary Recall [18] to determine energy and nutrient intake, and dietary quality, respectively. Information on individual dietary diversity was obtained by collecting data on foods/drinks consumed by children in the previous 24 hours. In the 24-Hour Dietary Recall, the portion sizes of the foods consumed in the previous 24-hours period were measured either in grams for solid foods or millilitres for liquid/semi-solid foods. Using the food composition table for central and eastern Uganda [19], energy and nutrient composition (energy, proteins, fibre, calcium, iron, zinc, vitamin A) of the portion sizes of individual foods consumed by each child in the 24-hour period was calculated, taking note of all the ingredients in the food matrix.

Anthropometry involved measurement of lengths and /or heights, weights, Mid-Upper Arm Circumference (MUAC) [20] as well as determination of the age of the children. The heights/lengths in centimeters (cm) and MUAC in millimeters (mm) were measured using stadiometer (Calibrated height board) and MUAC tapes, respectively. Weights in kilograms were measured to the nearest 0.1Kg using a calibrated mechanical Seca scale (https://www.seca.com/en_us.html) with the subjects standing shoeless and in light clothing on the scale with the baby in the arm and then without the baby in the arm. The difference between the weight of the mother without the child and the weight of the mother with the child was the weight of the baby.

Information on maternal socio-economic and demographic characteristics (age, occupation and education level), child demographic characteristics (sex, age), and age at introduction of food or drink to the child were collected using a semi structured questionnaire.

Statistical analysis

Data were analyzed from 267 and 380 lactating mothers in the first season and second season, respectively and presented for each season and districts because geographically, the districts are located in different agro-ecological zones. The energy and nutrient intake data were analyzed using descriptive statistics (mean ±Standard Deviation (SD), and proportions). The mean energy and nutrient intake was analyzed using ANOVA at 5% significance level ($p<0.05$). Data from IDD were analyzed by grouping the foods into categories [17], expressing the proportion of children consuming various food groups as percentages. The proportion of infants and children who met the minimum dietary diversity (MDD) was calculated. The MDD indicates consumption of at least four out of seven food groups in the previous 24 hours [21].

Anthropometric data sets were analyzed based on WHO 2006 standards (ANTHRO version 3.2.2 January 2011) and expressed as mean z-scores for weight-for-height (WHZ), weight-for-age (WAZ) and height-for-age (HAZ) at 95% confidence interval (95% CI) for different age groups of children. The proportion of malnourished children

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defined by reference cut-off of less than ±2 standard deviations of the z-score of the reference population of the same age and sex was also calculated.

Socio-economic and demographic characteristics were expressed as the proportion of participants in each of the categories including age, education level, occupation of mother and age and sex of the child. In addition, age of child at introduction of foods or water was analyzed.

Microsoft office excel 2007, Genstat version 12 and Statistical Package for Social Sciences (SPSS) version 20 were used to process the datasets for dietary assessment and demographic characteristics.

Ethical Clearance
The research was approved and registered by Uganda National Council of Science and Technology (UNCST).

RESULTS

Demographic characteristics
Demographic characteristics of lactating mothers and their children is indicated in Table 1. The table indicates that most of the lactating mothers were in the age ranges of 20-29 years (46.7 to 67.7%) and 30-39 years (26.2 to 45.3%). Although the main occupation of the mothers was subsistence farming in all the districts in planting and harvesting seasons, firewood sale and charcoal burning was among the key livelihood activities especially in Moroto and Kaabong and Amudat. Other livelihood activities included brewing (in Moroto and Abim), retail trade (in Amudat and Abim), and gold mining (in Moroto). Generally, education level was low; high proportions of lactating mothers (62-97.8%) with exception of Abim (26.2-28.7%) never attended any formal education. The proportion of lactating mothers in Abim who did not attend any formal education was 26.2% and 28.7% in the harvesting and planting seasons, respectively (Table 1). Most of the children were females (47-61%) compared to their male counterparts (38-52%). Additionally among the children studied, 10-47.7% were between 0-23 months old (Table 1).

Age at introduction of complementary foods
The results (Table 2) also indicated that the age at first introduction of any food or drink varied across the districts with some mothers introducing food as early as at birth in Moroto (4.1%) and Amudat (1.2%) during planting season. As indicated in Table 2, across the districts and seasons, most lactating mothers started giving various foods or drinks to their infants from 4-6 months. Less than half of the lactating mothers (26.7-41.9%) introduced any food or drink to the child at six months of age. In all the districts and across seasons, some lactating mothers delayed the first introduction of any food or drink to their infants to either 7 or 8 months.

Dietary quality, energy and nutrient intake
Consumption of food groups in the districts for each season is presented in Table 3. The most commonly consumed food groups in the children’s diets were cereals,

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followed by vegetables and milk and/or milk products. A considerable proportion (10.1-46.8%) of the diets of children also included oils and fats. Other animal products (organ meat, flesh meat, fish, eggs, fish and seafoods), vitamin A rich fruits, vegetables and tubers were lacking in the diet of most children as they were among the least food groups consumed. Fermented alcoholic drinks or residue from these alcoholic drinks is not in the conventional food groups in the IDDS but was included in the food group because it is typical in the Karamoja sub-region where it constitutes part of the diet in many households. These fermented alcoholic beverages were processed cereals such as sorghum, maize and millet. In addition, fermented alcoholic drinks from sesame were also consumed. The results indicate that these fermented alcoholic drinks and/or some of their residues were consumed by about a quarter of the children in Moroto and Kaabong during the main planting season (Table 3).

The mean energy and nutrient intakes of children varied between seasons and among the districts (Table 4). There was disparity in average energy and nutrient intake by children of the same age group across all districts and season as indicated by the different mean amounts of intake.

Nutrition status of children

The result (Table 5) shows generally higher proportions of children below -2SD during planting season than harvesting season although their mean z-scores were within the normal range (±2SD) for all the anthropometric indicators. The median of the z-scores for height for age (Figures 2 and 3) and MAUC for age (Figures 4 and 5) shows a general shift to the left of the WHO median for the same age and sex mostly at z scores of -1to -2. These figures (1-4) indicate variations in nutritional status across seasons, sexes, districts and indicators.

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Nutritional status of children according sex compared to WHO standards

Height-for-Age in harvesting season

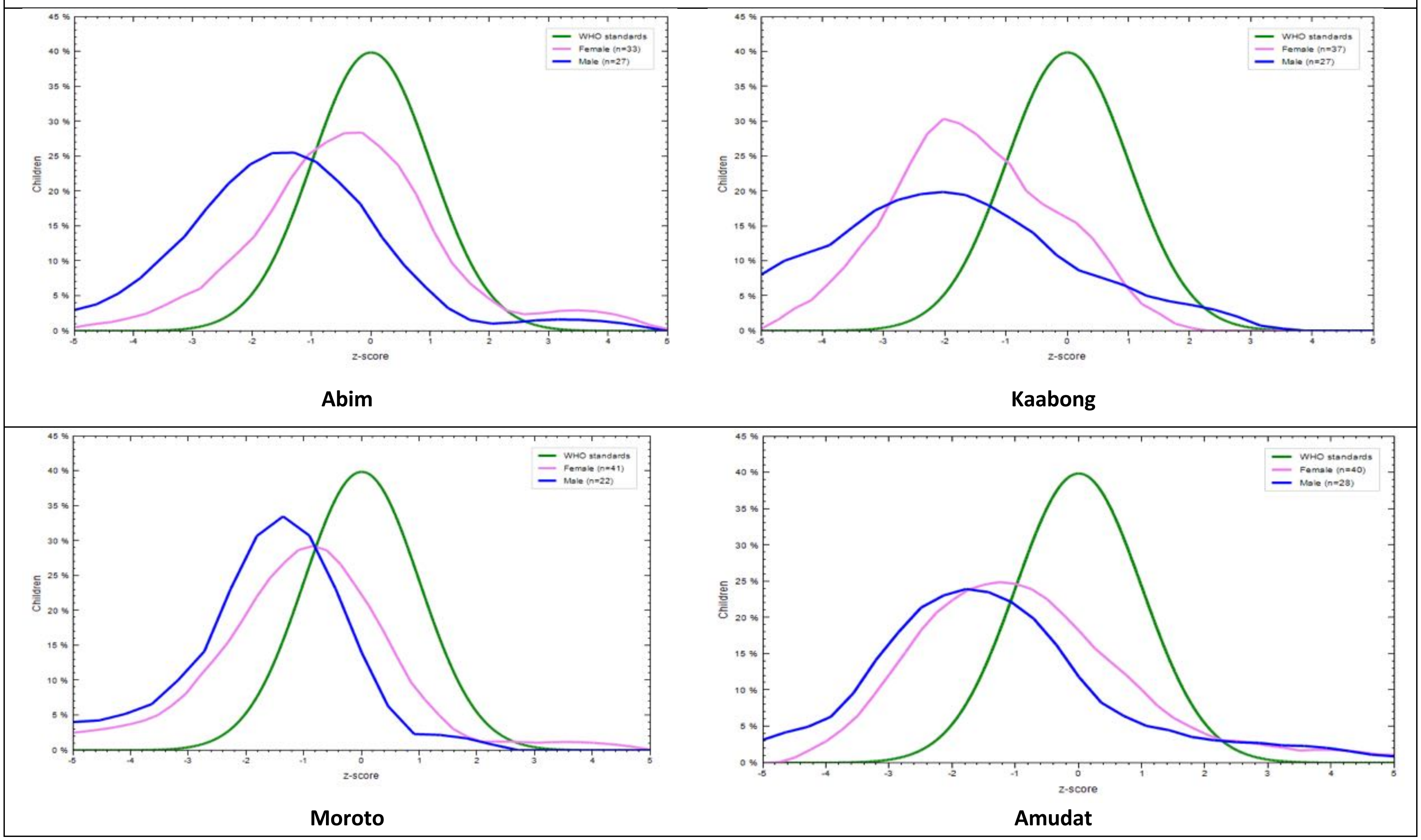

Figure 1: Height for Age of children compared with WHO standard for the same age and sex in harvesting season

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Height-for-Age in planting season

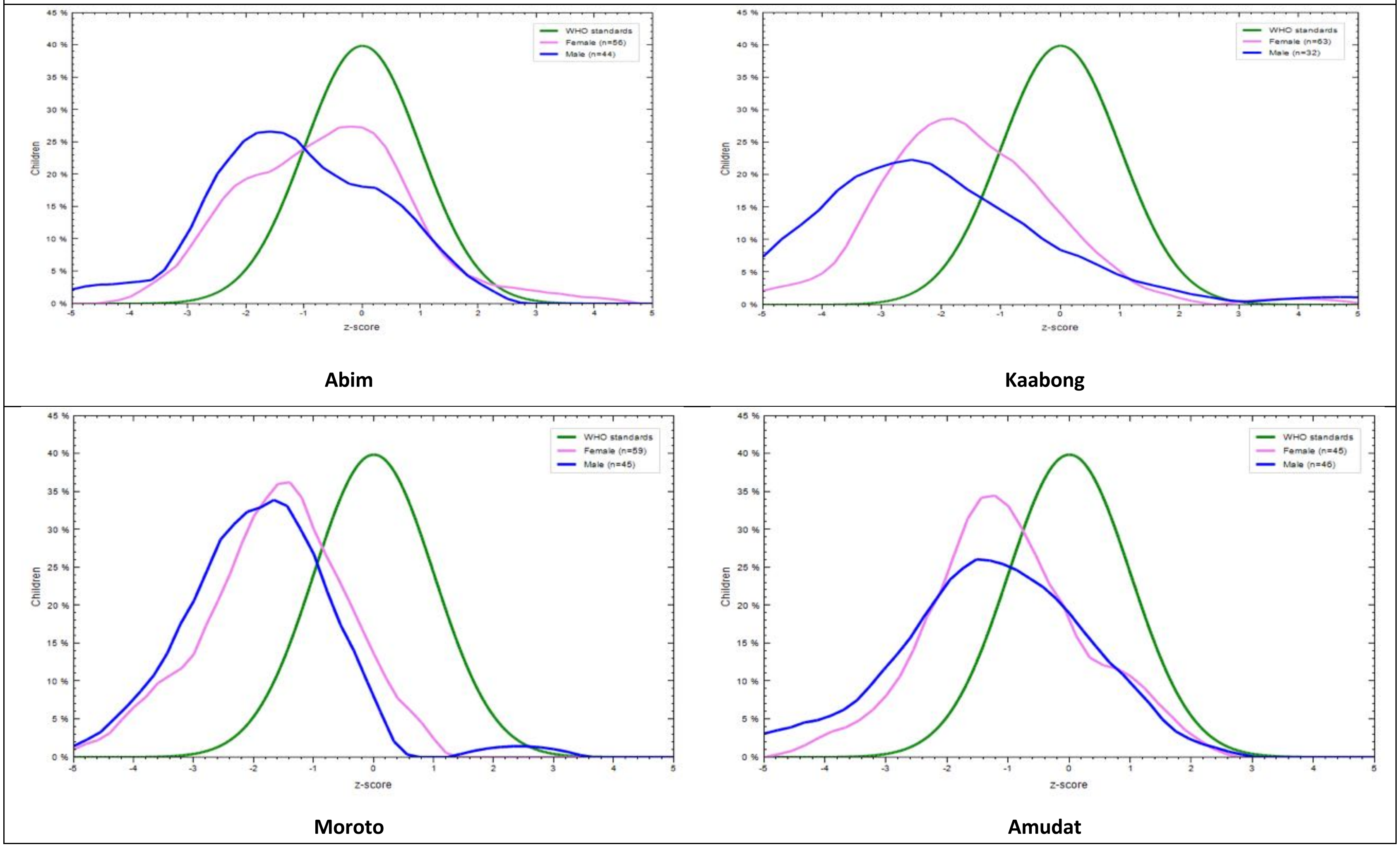

Figure 2: Height for Age of children compared with WHO standard for the same age and sex in planting season

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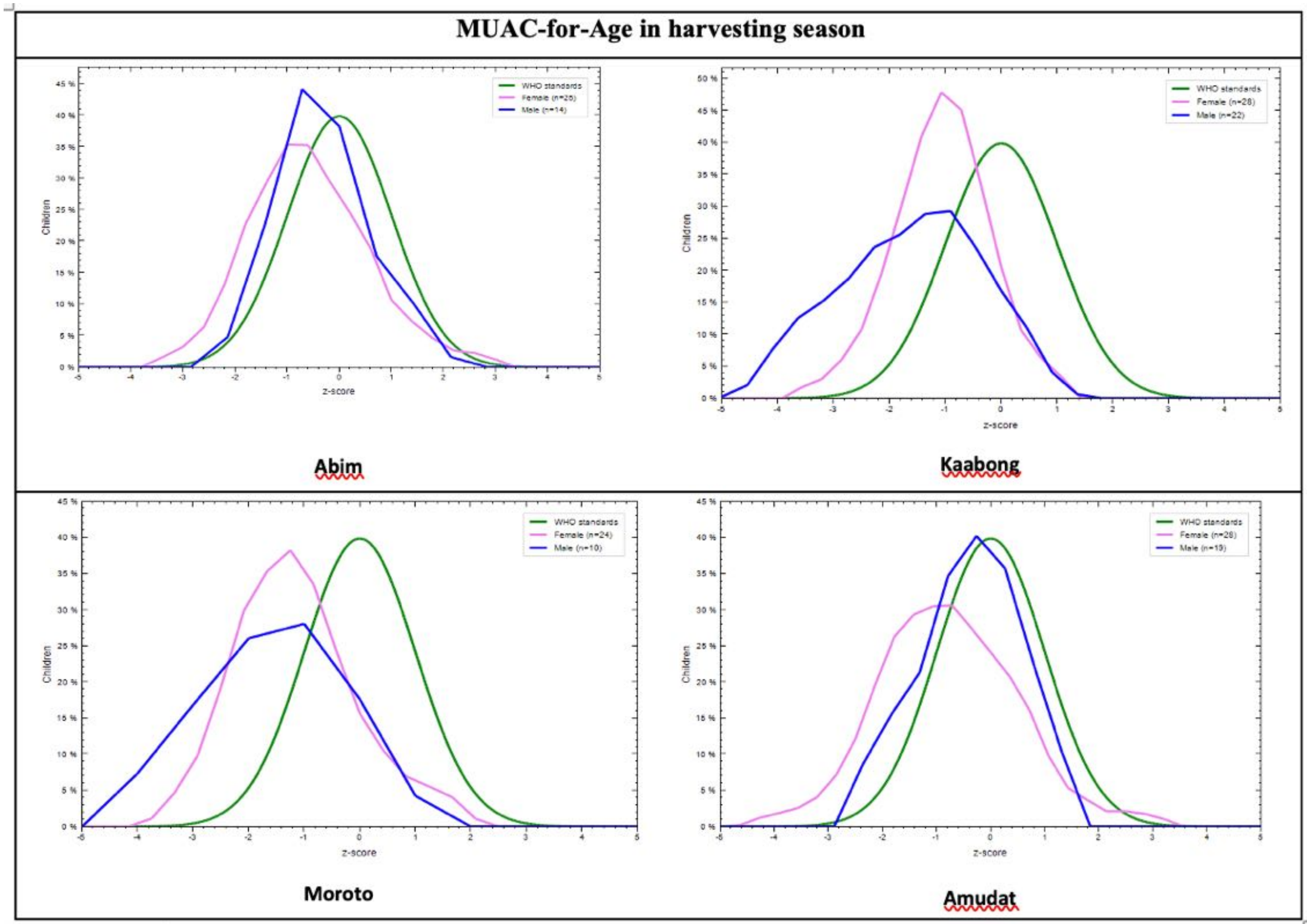

Figure 3: MUAC- for Age of children compared with WHO standard for the same age and sex in harvesting season

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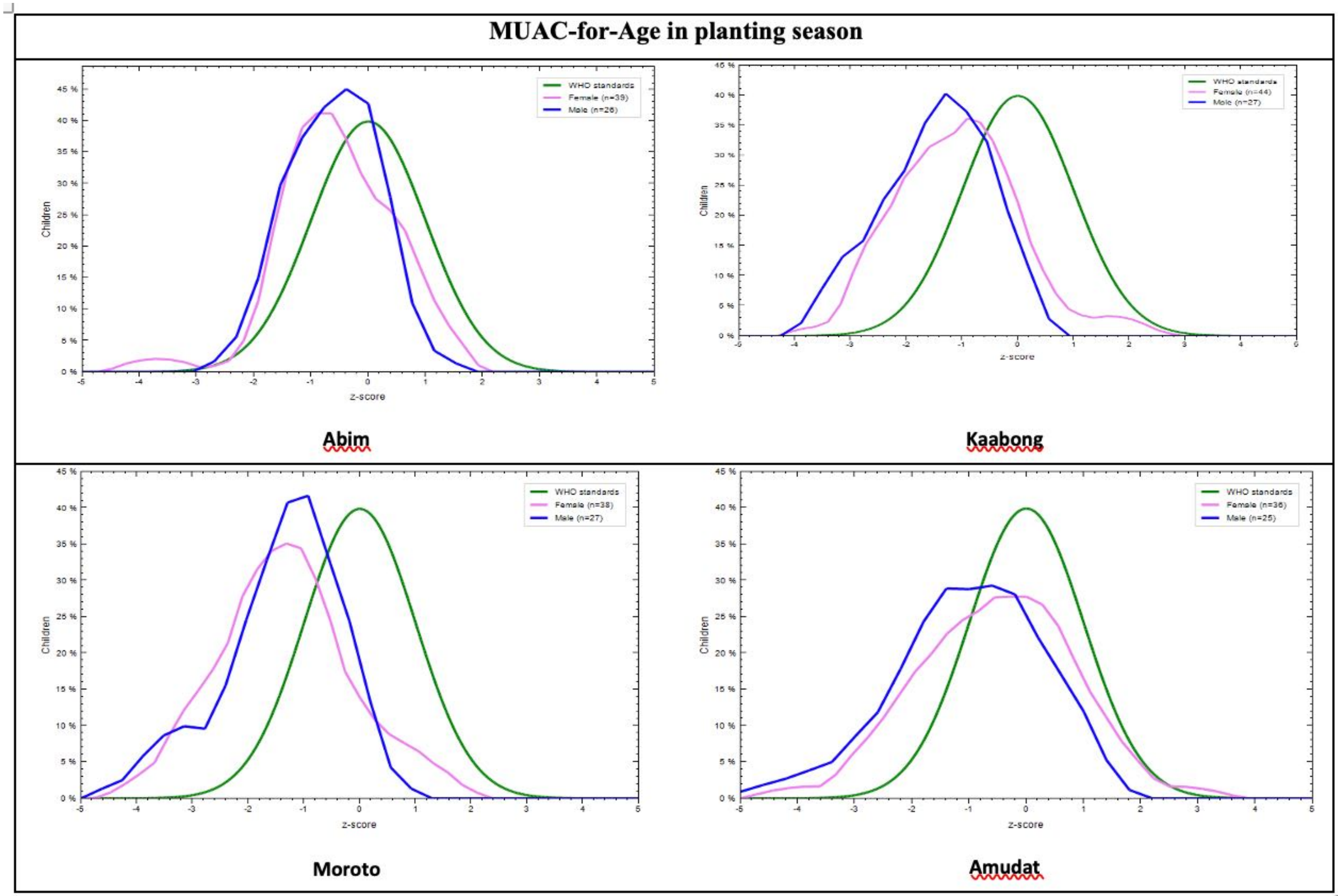

Figure 4: MUAC- for Age of children compared with WHO standard for the same age and sex in planting season

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DISCUSSION

Demographic characteristics

Previous studies attributed infant and young child feeding (IYCF) practices to both maternal characteristics and child characteristics [22, 23, 24]. Despite variations in the maternal characteristics reported by these previous studies, the findings agreed that maternal education level, marital status, age, occupation and geographical location were associated with IYCF practices. The child characteristics were attributed to birth weight, method of delivery and birth order, perceived size at birth, ethnicity, whether pregnancy was desired or not; and place of delivery [23], age of the child [22], birth interval for the index child [24]. It was established that socio-demographic factors especially young maternal age (below 25 years) and low maternal education (below 12 years) were associated with both short duration of breastfeeding and early introduction of solid foods [25]. Although the current study (Table 1) did not establish association between short duration of breastfeeding and early introduction of solid foods, and maternal age, most of the women were between 20-39 years. It is believed that regardless of maternal age, every woman involved in child care inevitably affects a child's nutritional status.

The low education attainment by mothers in the current study area depict likelihood of poor quality care to infants and young children on the basis of the association between education and child feeding practices in other studies. The UNICEF conceptual framework and several other modifications made to it identified lack of education as one of the basic causes of child malnutrition [26]. Mothers' education enables them make better healthcare decisions for their children, regardless of the economic level of the household [27]. In addition, the odds of undernutrition were lower among children whose mothers went to high schools [27]. Given the importance of maternal education in reducing the risk of malnutrition among children, the result implies that children in the Karamoja sub-region are at high risk of malnutrition because most of their mothers are illiterate.

Additionally, most of the lactating mothers derive their livelihood from subsistence rain-fed agriculture (Table 1). This poses a considerable challenge to food security because the sub-region has a 'unimodal' climate with roughly six months of rains (April – October) followed by a six- month dry season, hence, one harvest season in a year [11], creating seasonal food availability with food stocks running low from one harvesting season to another. Possible food shortages at emergency levels could also occur due to crop failures. Therefore, high dependence on rain-fed agriculture and low involvement in other socio-economic activities could increase the risk of food insecurity and consequently malnutrition among children due to a compromised economic access to foods. This should enhance the need for awareness campaign among the communities about the importance of gender empowerment.

Dietary quality, energy and nutrient intake

A major component of care is the set of practices caregivers employ to provide breast milk and complementary foods to children in their first year of life [21]. Complementary Feeding (CF) is the process which starts when breast milk alone is no longer sufficient to meet the nutritional requirements of infants and, therefore, foods are needed to complement breast milk intake from 7-23 months of age [28]. The WHO recommends exclusive breastfeeding (EBF) of infants for the first 6 months of life followed by continued breastfeeding and gradual introduction of appropriate and safe complementary foods until age 23 months [29]. It is widely acknowledged that the first two years of life is the 'critical window' for the promotion of optimal growth, health and development of children, during which they can become malnourished if they do not receive sufficient quantities of complementary foods containing adequate amounts of both micro- nutrients and macronutrients, even with optimum breastfeeding [3, 22]. The current study utilized IDD and 24-Hour Recall at different seasons to determine the dietary quality and energy and nutrient intake of the children who were already introduced complementary foods. The findings (Table 2) indicate that in both seasons, some children were introduced to complementary foods either too early (birth-5 months) or late (after seven months) contrary to the recommendations of WHO regarding EBF. Early introduction of liquids and solid foods increases the risk of diarrheal disease, one of the major causes of infant and young children morbidity and mortality in Africa [30], while too long a delay in introducing appropriate complementary foods may lead to nutritional deficiencies of iron, zinc, calcium, and sometimes vitamin A and riboflavin, because of the relatively low density of these nutrients in breast milk 4–9 months after birth [31].

Seasonal variations in food availability could be responsible for the variations in the MDD because the results indicate (Table 3) that during the harvesting season, the proportion of children meeting the MDD was high compared to those in planting season. As pointed out in similar studies [28], seasonality affects the quantity and types of food available, seasonal increases in food prices and variability in available incomes at the household level, all of which contribute to seasonal variations in the cost of an adequate diet. The findings (Table 3) also indicate poor dietary quality characterized by plant-based foods and lack of animal-based foods other than milk, which is a potential risk for micronutrient deficiency. The findings of the current research agrees with findings in previous studies that the diets of rural populations in most developing countries are based on cereals and legumes that are usually rich in phytate, while the consumption of animal-based foods rich in zinc and iron with high bioavailability was low [29]. Bioavailability of some essential trace elements such as zinc and iron may be affected in the presence of high content of phytate and dietary fibre available in cereal grains, legumes, some roots tubers, fruits, while calcium also has inhibitory effect on zinc absorption [32]. In Uganda the amount of food available to children partly depends on the quantity of food produced in the household, the number of people in the family, and income available to purchase food [33]. According to the current findings, most of the food consumed appears to come from subsistence farming, which is the key livelihood activity of lactating mothers in Karamoja sub-region.

The result (Table 4) also shows variations in the average intake of energy and nutrients with respect to seasons, districts and age groups, suggesting variations in the quantities and qualities of complementary food consumed. Energy and protein needs of infants are affected by a number of factors that include weight, growth rate, sleep/wake cycle, temperature and climate, physical activity, metabolic response to food, health status

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and recovery from illness [34]. With regard to energy requirements from complementary foods, infants 3-5 months, 6-8 months and 9-11 months need to consume 76 Kcal, 269 Kcal and 451 Kcal per day, respectively, while children 12-23 months consume 746 Kcal per day [35]. Comparing this with the results of the present study, generally, energy intake of infants (0-11 months) from complementary foods in Karamoja sub- region was adequate. However, generally the intake by young children (12-23 months) was not adequate. Protein requirements of infants are met when the energy intake is appropriate, except if there is a predominant intake of low protein foods such as cassava and sweet potatoes [36]. As such, recommended protein content (grams of protein per 100 kcal of food) for complementary foods is of 0.7 g/100 kcal, from 5 to 24 months [36]**.** Relating this recommended protein content of complementary foods and recommended protein intake of 12.5-19.7g per day for children 0-59 months [35] to the result of the present study (Table 4), protein intake of the complementary diet in Karamoja sub-region is generally adequate though the diets were mostly plant-based (Table 3). The protein quality of complementary foods was not a major issue with breastfeeding children due to the high amount of essential amino acids in breast milk and the digestibility of breast milk protein, which compensates for the poorer quality of protein in plant-based complementary foods [37].

In addition to proteins and energy, micronutrient intake from the complementary foods in the current study was generally adequate for calcium, iron, and zinc (Table 4). However, the major concern with these minerals is their bioavailability as diets are dominated with plant-based foods. Such foods are often associated with high levels of antinutritional factors that negatively affect mineral bioavailability [38]. None of the children met RDAs for vitamin A from the complementary foods consumed. The authors attributed this to composition of diet which is characterized by cereal, legumes, nuts and oil seed, as well as vegetables and milk and/or other dairy products and lack of vitamin A rich foods in diets of most infants and children. Consumption of green vegetables was not adequate to meet the recommended daily allowances of children on complementary feeding while fibre intake was below the RDA for all the children (1-3 years) despite the fact that most diets were plant-based. The intake of fibre in the complementary foods (Table 4) cannot be underestimated for its potential to cause negative consequences such as reduced weight gain, reduced appetite due to satiety and reduced energy intake [39].

The seasonal variations in the energy and nutrient intake in the present study (Table 4) differs from the findings of a similar study in Kenya that looked at effects of agricultural biodiversity and seasonal rainfall on dietary adequacy and household food security in rural areas [39]. The study in Kenya found significant increases in energy, carbohydrate, protein, saturated fat, sugar and fibre; micronutrients including zinc, iron and folate in the rainy season but vitamin A intake was not significantly different. Increase in the percentage of children consuming certain food groups also showed an upward trend innon-vitamin A rich fruits and vegetables, sugar, legumes, and dairy products, in the rainy season [40]. The differences in the findings might be attributed to socio- economic and demographic characteristics and the location where the current study was conducted in an area with different agro-ecological zones and complex in terms of ethnicity and weather patterns.

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In Uganda, nearly half of the population is food energy deficient while many rural Ugandans in particular have a diet that is poor in micronutrient-rich foods such as meat, fish, fruits and dairy [11]. The adverse health effects of insufficient consumption of proteins and energy are often compounded by deficiencies of vitamins and minerals, particularly iodine, iron, vitamin A and zinc [41]. Several observational studies using a convenience sample have shown associations between household food insecurity and inadequate intake of micronutrients in fruits and vegetables [42].

Nutrition status of the children

There is significant association of WHO complementary feeding indicators and breastfeeding indicators with child anthropometry [9]. During the first two years of life, children can become malnourished, which may result in stunting, if they do not receive sufficient quantities of quality complementary foods, even with optimum breastfeeding [43]. Therefore, the variations in nutrition status in the current study (Table 5; Figure 1-4) was partly, attributed to the feeding practices of lactating mothers in different seasons. The variations in the nutritional status of children also suggest differences in the availability of food, food consumption patterns in different locations. The poor nutritional status of the children as measured by the proportion of children<-2Z score for all the indicators has implications with regard to achievement of good nutrition within the first 1000 days. Children who become undernourished during the critical 1000-day window between conception and 24 months can have lifelong consequences such as cognitive deficits, and as adults, have lower academic achievement and lower economic status [44]. In addition, childhood undernutrition during the first two years of life has been associated with irreversible harm and is linked to higher rates of morbidity and mortality [3, 45], likelihood of stunting [44] and contributes to the intergenerational transmission of poverty and illness [45].

CONCLUSION

In conclusion, lactating mothers in Karamoja sub-region have low education level and socioeconomic status, which could have serious implications for maternal practices in breastfeeding and introduction of complementary foods to children.

The harvesting and planting seasons as well as differences due to location of the districts in Karamoja sub-region reflect variations and disparities in the dietary diversity, energy and nutrient intake, and nutrition status of children (0-3 years). Diet of children 0-3 years is dominated by plant-based foods during harvesting and planting seasons. Children 0-3 years in Karamoja sub-region have poor nutrition status in both harvesting and planting seasons.

Therefore, interventions for improving nutrition outcomes of infants and young children in Karamoja sub-region should be done within the context of seasonal and location challenge. To improve nutrition outcome of these children (0-3 years) in the sub-region, it is important for government and development agencies to embark on educating the mothers and other caregivers on formulation of nutritious diets from locally available foods and increase community awareness on appropriate infant and young child feeding practices. However, due to high levels of illiteracy among mothers and caregivers in Karamoja sub-region, such nutrition education should be implemented using simple methods such as pictures, practical demonstrations, dramas, music and dance, and community dialogues.

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Table 1: Demographic characteristics of lactating mothers and children according to district and season

Subject	Category of characteristics	Abim S¹	Abim S²	Kaabong S¹	Kaabong S²	Moroto S¹	Moroto S²	Amudat S¹	Amudat S²
	Age								
	15-17 Years	0.0	1.1	0.0	0.0	0.0	1.0	4.4	1.1
	18-19 Years	6.2	10.6	-	2.2	1.5	2.0	1.5	6.7
	20-29 Years	67.7	55.3	50.0	46.7	63.6	59.6	47.1	56.2
	30-39 Years	26.2	29.8	45.3	42.4	25.8	34.3	41.2	32.6
	40-49 Years	0.0	3.2	4.7	8.7	9.1	3.0	5.9	3.4
	N	65.0	94.0	64.0	92.0	66.0	99.0	68.0	89.0
	Occupation								
	Subsistence farming	95.4	100	92.2	100	75	37.5	89.4	98.9
	Casual labourer	-	-	-		2.9	4.8	1.5	1.1
	Firewood sale and charcoal burning	-	-	7.8	-	17.7	48.1	4.5	-
	Brewing	3.1	-	-	-	1.5	9.6	-	
Lactating Mother	Trader/seller	1.5	-	-	-	-	-	4.5	-
	Gold mining	-	-	-	-	2.9	-	-	-
	N	65	94	64	92	68	104	66	90
	Education level								
	No Formal Education/School	26.2	28.7	77.8	62.0	92.6	90.4	91.2	97.8
	Lower Primary Education (P1-P4)	13.8	18.1	17.5	31.5	2.9	6.7	1.5	-
	Upper Primary Education (P5-P7)	30.8	29.8	4.8	5.4	2.9	2.9	7.4	2.2
	O Level incomplete (<4 Years)	18.5	17.0	-	1.1	1.5	-	-	-
	O Level Complete (Sat UCE)	9.2	5.3	-	-	-	-	-	-
	A Level Complete (Sat UACE)	1.5	-	-	-	-	-	-	-
	Tertiary Training	-	1.1	-	-	-	-	-	-
	N	65.0	94.0	63	92	68.0	104.0	68	90

n is the sample size per district; S¹ is the harvesting season; S² is the planting season; The values in the table are in percent (%)

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Table 1 Continued

		Districts and Seasons							
		Abim		Kaabong		Moroto		Amudat	
Physiological status	**Category of characteristics**	S^1	S^2	S^1	S^2	S^1	S^2	S^1	S^2
Infants and children	**Sex**								
	Male	44.6	48.9	42.2	39.3	38.8	39.4	46.5	52.8
	Female	55.4	51.1	57.8	60.7	61.2	60.6	53.5	47.2
	N	65.0	94	64	89	67	104	71	89
	Age of children								
	< Six months	40.0	36.6	23.8	46.1	38.8	45.2	25.4	47.7
	6-11 months	23.1	34.4	34.9	18.0	35.8	23.1	32.4	20.5
	12-17 month	21.5	14.0	25.4	20.2	10.4	21.2	32.4	18.2
	18-23 months	13.8	8.6	9.5	4.5	7.5	5.8	9.9	12.5
	24-29 months	1.5	6.5	6.3	9.0	7.5	2.9	0.0	1.1
	30-35 months	0.0	0.0	0.0	2.2	-	1.9	0.0	0.0
	N	65.0	93.0	63.0	89.0	67.0	104.0	71.0	93.0

n is the sample size per district; S^1 is the harvesting season; S^2 is the planting season; The values in the table are in percent (%)

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Table 2: Age of children at introduction of complementary foods

	Districts and Seasons							
	Abim		Kaabong		Moroto		Amudat	
Age	S^1	S^2	S^1	S^2	S^1	S^2	S^1	S^2
Not started	32.8	38.0	24.6	45.6	35.5	32.0	24.6	47.1
At birth	-	-	-	-	-	4.1	-	1.2
One month	5.2	-	1.5	1.1	-	1.0	0.0	2.4
2 months	0.0	0.0	0.0	-	1.6	1.0	1.5	3.5
Three months	3.4	5.4	9.2	0.0	0.0	3.1	9.2	4.7
Four months	13.8	5.4	7.7	5.6	3.2	12.4	7.7	4.7
Five months	5.2	7.6	7.7	12.2	6.5	13.4	7.7	2.4
Six months	36.2	37.0	38.5	26.7	41.9	29.9	38.5	30.6
Seven months	1.7	4.3	4.6	6.7	9.7	1.0	4.6	3.5
Eight months	1.7	2.2	6.2	2.2	1.6	2.1	6.2	-
N	58.0	92	58.0	90	62.0	97.0	65.0	85.0

n is the sample size per district; S^1 is the harvesting season; S^2 is the planting season; The values in the table are in percent (%)

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Table 3: Proportion (%) of children who consumed various food groups and minimum dietary diversity (MDD) segregated by district and season

Category		Protortion (%) by district and season							
		Abim		Kaabong		Moroto		Amudat	
		S^1	S^2	S^1	S^2	S^1	S^2	S^1	S^2
Food groups consumed	1.Cereals	65.5 (52)	46.3 (95)	69.8 (63)	52.7 (91)	56.7(67)	57.7 (104)	57.7(71)	39.3 (89)
	2.White roots and tubers	10.9 (46)	10.5 (95)	0 (62)	1.1 (91)	1.5 (67)	0 (104)	0 (71)	0(89)
	3.Vitamin A rich vegetables and tubers	28.9 (45)	0(95)	9.7(62)	0(91)	4.5 (67)	0(104)	0 (71)	0(89)
	4.Dark Green Leafy Vegetable (DGLV)	21.7(46)	26.3 (95)	48.4 (62)	37.0(91)	37.3 (67)	26.0 (104)	39.4 (71)	18.0(89)
	5.Other vegetables	13.3 (45)	18.9 (95)	24.2 (62)	5.5 (91)	11.9 (67)	2.9 (104)	18.3(71)	0 (89)
	6.Vitamin A rich fruits	8.9 (45)	4.2 (95)	0 (62)	1.1(91)	0(67)	2.9 (104)	0 (71)	0 (89)
	7.Other fruits	0.0(46)	0.0 (95)	0.0 (62)	0.0. (91)	0.0(67)	0.0 (104)	0.0(71)	0.0(89)
	8.Organ meats	0 (46)	0 (95)	0 (61)	0 (91)	0 (67)	0 (104)	0 (71)	0 (89)
	9.Flesh meats	8.7 (46)	0 (95)	4.8 ((62)	8.8 (91)	1.5 (66)	2.9 (103)	1.4 (71)	0 (89)
	10.Eggs	6.5 (46)	1.1 (95)	1.6 (62)	0 (91)	0 (67)	0 (104)	0 (71)	0 (89)
	11.Fish and sea foods	8.9 (45)	7.4 (95)	4.8 (62)	2.2 (91)	0 (67)	2.9 (104)	1.4 (71)	0 (89)
	12.Legume, nuts and seeds	62.2 (45)	44.2 (95)	41.3 (63)	22.0 (91)	31.3 (67)	25.0 (104)	5.6 (71)	2.2 (89)
	13.Milk and milk products	21.7 (46)	3.2 (95)	39.3 (61)	33.6 (91)	44.8 (67)	32.7 (104)	67.6 (71)	41.6 (89)
	14.Oils and fats	44.4 (45)	31.9 (94)	46.8 (62)	15.4 (91)	16.4 (67)	19.2 (104)	29.6 (71)	10.1 (89)
	Local beer and beer residue[1]	2.2 (46)	1.1 (93)	0 (62)	17.6(91)	1.5 (67)	26.9 (104)	0 (71)	0 (89)
MDD[2] met by children (6-23 months)		36.1(36)	30.2 (53)	24.5 (49)	6.7 (45)	39.5 (43)	28.9 (38)	38.9 (36)	11.5 (52)

[1] Local beer and its residues are not in the conventional food groups for dietary diversity but included in among the foods because of its regular consumption in the sub-region

[2] (MDD indicator was calculated based on consumption of at least four of the following seven food groups: (1) grains, roots and tubers; (2) legumes and nuts; (3) dairy products; (4) flesh foods; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables

S^1 is the harvesting season; S^2 is the planting season

Figures in bracket are the number of children that participated in the study

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Table 4: Mean energy and nutrient intake from complementary foods among children of different age groups segregated by district and season

Energy and Nutrients	Age groups (months)	Mean(±Standard deviation)energy and nutrition intake							
		Abim		Kaabong		Moroto		Amudat	
		S[1] (n=30)	S[2] (n=52)	S[1](n=46)	S[2] (n=52)	S[1] (n=38)	S[2] (n=67)	S[1] (n=52)	S[2] (n=45)
Energy (Kcal/day)	0-5	143.4 ±155.3	340.8±358.3	661.9±269.7	585.7±220.0	683.2±524.1	612.9±479.7	230.6±119.9	558.5±374.6
	6-11	404.4±168.6	301.8±260.6	415.6±260.7	705.8±309.7	278.5±251.2	677.4±447.6	522.4±331.6	801.0±370.1
	12-23	631.0±441.3	576.7±271.9	641.4±409.4	719.0±390.6	605.4±351.5	799.1±493.3	603.5±233.2	851.3±443.2
	24-35	424.7±0.0	798.3±580.0	712.7±212.8	755.1±371.2	325.1±0.0	1012.4±485.1	-	707.9±165.8
Proteins (g/day)	0-5	5.8±7.6	12.6±10.4	25.5±11.0	19.8±6.4	24.7±19.9	18.4±16.5	10.5±6.8	19.5±11.2
	6-11	13.3±9.5	12.3±12.1	13.2±9.0	28.0±12.8	9.6±8.6	21.6±13.8	16.9±14.0	26.5±11.4
	12-23	21.2±16.2	22.2±10.0	20.3±15.4	28.1±18.9	21.8±13.2	27.5±16.4	16.9±8.5	25.9±14.9
	24-35	18.1±0.0	29.4±21.7	21.3±5.3	25.8±12.2	13.3±0.0	34.8±12.4	-	28.2±3.6
Fibre(g/day)	0-5	3.5±3.5	4.9±4.5	8.7±6.1	10.4±4.9	12.3±9.4	7.2±7.4	1.6±2.6	4.4±5.5
	6-11	5.9±4.2	5.5±5.4	6.2±4.8	12.1±5.9	4.2±4.1	10.0±8.5	5.3±5.4	7.5±6.8
	12-23	11.4±7.2	10.4±5.5	10.0±6.9	10.9±5.7	7.8±6.0	9.9±6.1	5.5±4.0	8.8±6.4
	24-35	9.7±0.0	14.1±8.0	13.5±5.2	14.1±7.2	3.7±0.0	16.0±10.3		5.8±5.0
Calcium (mg/day)	0-5	239.1±397.4	214.4±373.0	413.1±293.9	158.8±108.9	362.4±305.3	354.8±281.9	366.8±227.8	580.7±329.9
	6-11	205.9±380.8	138.0±176.3	145.4±193.2	487.4±368.3	104.3±118.7	352.6±257.1	444.6±440.3	737.6±373.4
	12-23	306.9±358.8	200.6±249.8	254.6±406.0	401.7±406.3	386.8±359.5	495.5±440.6	478.6±326.8	711.0±502.0
	24-35	530.7±0.0	436.9±651.9	117.2±91.9	238.4±137.6	248.5±0.0	364.6±159.6		911.2±225.3
Iron (mg/day)	0-5	5.2±8.2	5.4±7.3	5.5±4.1	5.8±3.2	9.8±7.8	4.8±4.9	0.2±0.2	1.8±2.0
	6-11	2.9±2.3	4.2±4.2	3.7±3.2	7.1±3.2	2.8±2.8	6.1±4.8	2.0±1.8	3.1±2.6
	12-23	7.3±6.5	7.2±4.8	5.3±3.7	7.0±3.6	5.5±3.8	6.9±4.9	2.1±1.3	3.5±2.6
	24-35	12.8±0.0	13.1±13.4	7.1±2.5	8.8±4.6	2.6±0.0	10.2±6.1	-	2.1±1.6
Zinc (mg/day)	0-5	1.5±2.3	2.2±2.7	4.4±2.3	3.1±0.9	4.0±2.9	2.6±2.3	1.3±0.9	2.9±1.8
	6-11	2.2±1.5	1.7±1.6	2.0±1.5	4.3±2.0	1.5±1.5	3.7±2.3	2.8±2.3	4.1±1.9
	12-23	3.5±2.9	3.0±1.7	3.3±2.5	4.1±2.6	3.6±2.2	4.3±2.6	2.8±1.3	4.1±2.2

Energy and Nutrients	**Age groups (months)**	**Mean(±Standard deviation)energy and nutrition intake**							
		Abim		**Kaabong**		**Moroto**		**Amudat**	
		S[1] (n=30)	**S[2] (n=52)**	**S[1](n=46)**	**S[2] (n=52)**	**S[1] (n=38)**	**S[2] (n=67)**	**S[1] (n=52)**	**S[2] (n=45)**
	24-35	4.0±0.0	5.5±5.0	3.5±1.1	4.1±2.3	1.8±0.0	5.0±1.8	-	3.9±0.5
Vitamin A[1] (µg/day)	0-5	223.6±382.6	45.7±49.3	95.9±78.2	66.0±31.4	259.4±259.4	141.4±165.3	81.6±34.2	129.5±76.6
	6-11	51.2±63.0	95.5±140.3	92.4±115.5	133.5±97.6	33.7±43.6	153.4±159.5	102.1±84.1	161.0±98.8
	12-23	119.9±152.9	144.0±136.0	117.1±114.3	161.4±110.9	121.9±123.0	264.0±369.9	133.0±58.8	189.8±143.6
	24-35	513.4±0.0	79.2±93.4	175.0±51.1	150.5±110.7	49.7±0.0	146.7±62.5		199.1±62.4

[1]Vitamin A was calculated as Retinol Activity Equivalents (RAE)
S[1] is the harvesting season; S[2] is the planting season; n is the number of children studied

RDAs for infants 0-6 months: Calcium=210 mg/d; Iron=0.27mg/d, Zinc=2mg/d, Vitamin A=400 µg/day [38]
RDAs for infants 7-12 months: Calcium=270mg/d, Iron=11mg/d, Zinc=3mg/d, Vitamin A=500 µg/day [38]
RDAs for children 13-36 months: Calcium=500mg/d, Iron=7mg/d, Zinc=3mg/d, Vitamin A=300 µg/day, Fibre=19 [38]
RDAs for protein (g/d): 0-3 months=12.5; 4-6 months=12.7; 7-9 months=13.7; 10-12 months=14.9; 13-36 moths 14.5

RDAs for energy (Kcal/d) Boys: 0-3months=545; 4-6 months=690; 7-9 months=825; 10-12 months=920; 13-36 months 1230 [34]

RDAs for energy (Kcal/d) Girls: 0-3months=515; 4-6 months=645; 7-9 months=765; 10-12 months=865; 13-36 months 1165 [34]

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Nutrition Status of children

Table 5: The proportion (%) of children below -2SD and mean z scores (Standard deviation (SD) according to district and season

		District															
		Abim				**Kaabong**				**Moroto**				**Amudat**			
Nutrition Indicator	**Season**	**% < -2SD**	**(95% CI)**	**Mean (SD)**	**N**	**% < -2SD**	**(95% CI)**	**Mean (SD)**	**n**	**% < -2SD**	**(95% CI)**	**Mean (SD)**	**n**	**% < -2SD**	**(95% CI)**	**Mean (SD)**	**n**
Weight-for-length/height	S^1	0	0- 1.2	-0.06 (0.94)	43	28.6	15.8-41.3	-1.1 (1.38)	56	13.8	4.1-23.5	-0.37 (1.85)	58	18.6	8.7-28.4	-0.75 (1.64)	70
	S^2	6.5	0.9-12	-1.03 (1.32)	93	27.8	18.4-37.3	-1.46 (1.52)	97	33.3	23.7- 43	-1.1 (1.6)	102	35.9	25.5-46.2	-1.17 (1.8)	92
Length/height-for-age	S^1	23.3	11.8- 34.9	-0.87 (1.64)	60	36.5	23.8-49.2	-1.72 (1.5)	63	23.8	12.5-35.1	-1.33 (1.54)	63	27.9	16.5-39.3	-1.05 (1.79)	68
	S^2	20	11.7- 28.3	-0.86 (1.43)	100	48.4	37.8- 59	-1.74 (1.66)	95	38.5	28.6-48.3	-1.77 (1.16)	104	24.2	14.8-33.5	-1.18 (1.37)	91
Weight-for-age	S^1	0	0%-1.1	-0.21 (1.44)	47	50	36.3-63.7	-1.85 (1.45)	38	24.2	12.7-35.7	-0.82 (1.91)	62	23.2	12.5-33.9	-1.19 (1.61)	69
	S^2	24.2	15.3- 33.2	-1.11 (1.5)	99	50	39.6-, 60.4	-2.0 (1.71)	98	50.5	40.4-60.5	-1.99 (1.43)	105	36.4	25.7- 47	-1.55 (1.62)	88
BMI-for-age	S^1	15.8	5.4- 26.1	-0.46 (1.63)	57	28.6	15.8-41.3	-1.04 (1.48)	56	12.1	2.8-21.3%)	-0.44 (1.74)	58	21.4	11.1-31.8	-0.7 (1.62)	70
	S^2	20.2	11.6- 28.9	-1.07 (1.4)	94	28.9	19.3-38.4	-1.46 (1.34)	97	30.4	21- 39.8	-1.18 (1.53)	102	31.8	21.5-42.1	-1.2 (1.66)	88
MUAC-for-age	S^1	5.1	0-13.3	-0.49 (0.99)	39	18.4	6.5-30.2	-1.25 (0.96)	49	21.2	5.7-36.7	-1.25 (1.07)	33	6.4	0- 14.4	-0.63 (1.08)	47
	S^2	4.6	0-10.5	-0.57 (0.9)	65	25.4	14.5-36.2	-1.23 (1.01)	71	23.1	12.1-34.1	-1.37 (1.07)	65	19.7	8.9-30.5	-0.73 (1.26)	61

n is the number of children
S^1 is the harvesting season; S^2 is the planting season; n is the number of children studied
Values in brackets are standard deviation; Values are based on WHO standards
For each indicator all children are included in the evaluation with a plausible z-score (defined under Survey options)
Percentages below median based on weight-dependent indicators are defined as <-3 SD or oedema, and <-2 SD or oedema. Oedema cases are not used to derive mean and SD of z-scores
%<-2SD includes %<-3SD; Number of children with oedema: 0 (this number may be used to calculate the prevalence of oedematous malnutrition in a sample)

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